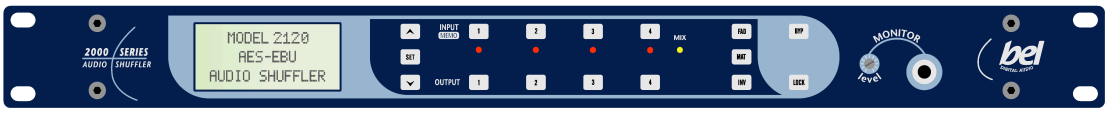
Bel 2120B

Analogue/AES/SDI
Shuffler



User's Guide

Version 1.0 06/05/04

BEL (Digital Audio) Ltd. has made every effort to ensure the accuracy of information contained within this document which is nevertheless supplied for information purposes only and does not constitute any form of warranty or guarantee.

All trademarks acknowledged.

The information in this document is subject to change without notice.

Bel Digital Audio Ltd.
Unit 3
Horwood Court
Bletchley
Milton Keynes
Bucks
MK11RD
Tel: 01908-641063
Email: info@beldigital.com
Web: www.beldigital.com

INTRODUCTION **5**

FEATURES **5**
Input Switching and routing 5
Inputs 5
Input Levels 5
Phase Reversal 5
Outputs 5
Monitor Outputs 5
Memory 6
Keyboard lock 6

Front panel controls **6**
LCD Graphic Display 6
Nudge up/down ∧ ∨ 6
SET 6
Input/Output 6
FAD 6
MAT 7
BYP 7
LOCK 7
Monitor level and output jack 7

FIG 1.1 BEL 2120B FRONT PANEL **8**

FIG 1.2 BEL 2120B REAR PANEL **8**

OPERATION **9**
Matrix mode operation 9
Mixer mode operation 10

SETUP **11**
Page 1. Memory functions 11
Page 2. Mode selection 11
Page 3. Headphone monitor source selection 11
Page 4. Input source selection 12
Page 5. SDI group selection 12
SDI output select 12
Analogue output select 13
AES output select 13
SDI video standard select 13
Ingroup deletion 13
Input levels/ Analogue input gain adjustment 14
Output levels/ Analogue output gain adjustment 14
Communications address 14

© 2004 BEL Digital Audio Ltd.

RS422 Serial control **15**

Rear Panel Connectors **15**

Pin Connections **15**
EMC compliance 16

Specification Bel Model 2120B **17**
SDI I/O 17
Analogue Inputs 17
Analogue outputs 17
AES-EBU Digital I/O 17
General 17
The Bel2120B Serial Protocols 18
Overview 18
Frame format 18
Commands 19
General data format 20

APPENDIX A **21**
2120B operational description 21

© 2004 BEL Digital Audio Ltd.

BEL 2120
SDI Shuffler

INTRODUCTION

The Bel 2120 can process any combination of analog, AES or SDI audio signals and simultaneously output the result in any of these formats. The audio can be routed, mixed, inverted and level shifted. A headphone monitor jack is also provided on the front panel.
The unit can be controlled by front panel switches or remotely.

Features

Input Switching and routing

The unit can operate in one of two main modes, Matrix or Mixer. In the Matrix mode available audio input can be selected, modified and directed to any output. In the Mixer mode any combination of inputs can be selected, mixed and directed to any output. (See operational detail)

Inputs

The inputs accepted by the Bel2120 are organized in pairs. Input pairs from analog, AES or SDI (any group) can be accepted.

Input Levels

In either mode gain can be applied to the selected inputs before redirection or mixing. The gain can be adjusted over the range +10 to -30 dB.

Phase Reversal

In either mode the selected inputs can be phase reversed before routing or mixing.

Outputs

The BEL 2120 provides simultaneous analog, AES and SDI (any group) outputs.

Monitor Outputs

A stereo headphone output is provided on the front panel to allow any pair of outputs to be monitored. The signals on the left and right monitor outputs can be selected via the setup system.

© 2004 BEL Digital Audio Ltd.

Memory

The operating mode and current setup are stored in one of eight memories. This information is retained when the unit is switched off. The memory can be reset to the factory default settings by depressing the set key while the BEL logo is displayed at power on.

Keyboard lock

Inadvertent operation of the keys can be avoided by invoking the key 'lock' function.

Front panel controls

Several push buttons and indicators are located on the front panel, Fig 1.1, from left to right these are:

LCD Graphic Display

On power-up the LCD will show model number, software version and model description for a few seconds before resetting to the default display. In its default mode the LCD will display:

- Current input to output connections
- Gains and phase reversal settings for each input
- Memory number
- State of the FAD, MAT, BYP and LOCK switches

Nudge up/down ∧ ∨

These buttons are used to adjust input gains when the default screen is visible and the value of parameters within the setup menus.

SET

This key will enter the setup menus. See setup section for details of this operation.

Input/Output

Two horizontal rows of switches control the input and output selection. The upper row marked 1 to 4 are the input selection switches. The lower row are the output selectors. A red LED indicator positioned beneath each input switch will show the currently active input channel. See below for detail of their use.

FAD

This switch is only functional in the matrix mode and can be used to override any gain adjustments imposed on the input audio. If the character F is not shown in inverse video on the right hand side of the LCD display all inputs are passed to the selected outputs without gain adjustment. The gains shown on the LCD will be

© 2004 BEL Digital Audio Ltd.

contained in outline boxes. These values can be adjusted but the gain variation will not take effect until the FAD switch is activated.

MAT

This switch is only functional in the matrix mode and can be used to override any redirection imposed on the input audio. If the character M is not shown in inverse video on the right hand side of the LCD display all inputs are passed to their appropriate output. i.e. in 1 to out 1, in 2 to out 2 etc. The discs connecting input lines to output lines will be replaced by outline squares. The position of these connections can be adjusted but the actual input/output assignment will not be made until the MAT switch is activated.

BYP

This switch will activate an electronic bypass and is a combination of FAD and MAT. No gain adjustment or redirection of the inputs occurs when the character B is shown in inverse video on the right hand side of the LCD display.

LOCK

When the unit is 'locked' all the front panel keys, except LOCK, are inoperative. To release the keys press and hold the LOCK key for a period in excess of five seconds. A momentary press of the LOCK key will again place the unit in the lock mode. The locked mode is indicated by the character L shown in inverse video on the right hand side of the LCD display.

Monitor level and output jack

The headphone monitor output is available from this 6 mm stereo Jack. The outputs to this jack can be selected in the setup menus; the audio level is set by the small knurled control.

© 2004 BEL Digital Audio Ltd.

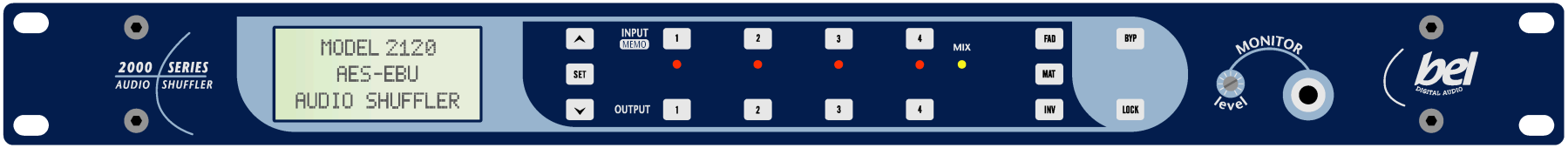


Fig 1.1 Bel 2120B Front panel

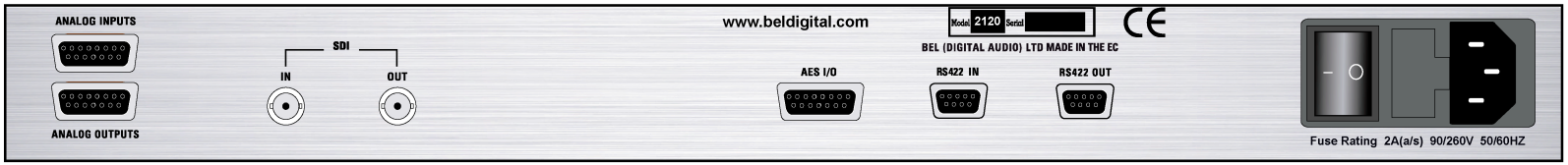


Fig 1.2 Bel 2120B Rear panel

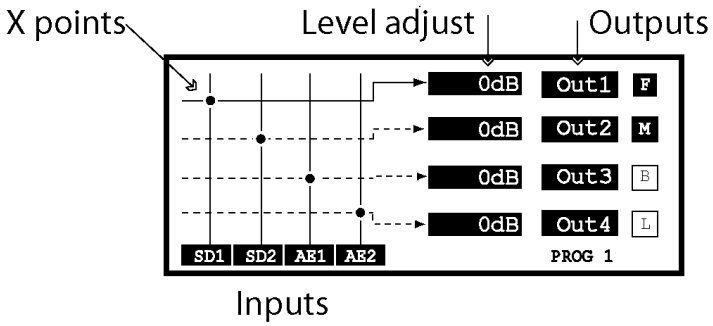
© 2004 BEL Digital Audio Ltd.

OPERATION

The BEL 2120 Shuffler can operate in either the Matrix or the Mixer mode.

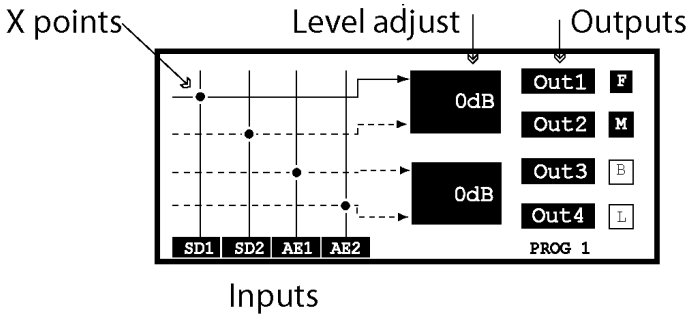
Matrix mode operation

In the quad matrix mode of operation each of the four ***output*** channels can have one of the inputs associated with it. The inputs can be derived from the SDI , AES or analog inputs. The gain and phase of each input can be modified, depending on the state of the FAD, MAT and BYP controls, before being passed to the output. The LCD display, in this mode, shows the 4 output channels, their associated input and its gain or phase modification.



To operate in the quad matrix mode first ensure that quad matrix is selected in the setup menu. The Matrix modes can be confirmed if the amber LED to the right of input switch 4 is extinguished. Then select the OUTPUT required by depressing the appropriate numbered switch on the lower horizontal row. The output selected will be indicated by a solid line on the matrix on the LCD display, the current input channel associated with this output is indicated by the LED. If required the input channel can now be changed by depressing the required switch on the upper row. The level of that channel can be adjusted by depressing the nudge ∧∨ keys, the current level in dBs will be shown on the LCD display. A phase reversal can be applied to the input channel by depressing the INV switch. The phase reversal is indicated by a ↓ symbol on the LCD display positioned beside the corresponding output.

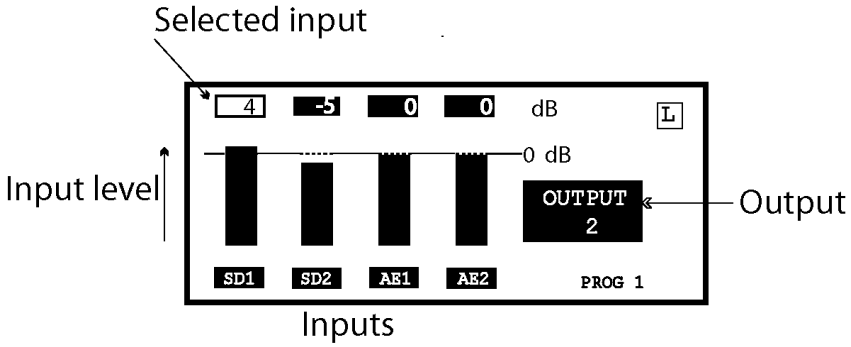
The dual matrix mode is identical to the quad matrix mode except that level adjustments are applied to pairs of inputs. This feature facilitates accurate tracking of stereo pairs. The dual matrix mode can be selected in the setup menu.



© 2004 BEL Digital Audio Ltd.

Mixer mode operation

The mixer mode, identified by the amber LED, provides the facility to select and mix a combination of any inputs and direct the result to any output. As with the Matrix mode, gain and phase reversal can be applied to the selected inputs. In this mode the LCD display will show a different screen for each ***output*** selected. The display will indicate the level and phase reversal of each input together with the current input for adjustment.



To operate in the Mixer mode first ensure that Mixer is selected in the setup menu. The amber LED to the right of input switch 4 is active. Then select the ***output*** required by depressing the appropriate numbered switch on the lower horizontal row. The page corresponding to the output selected will be shown on the LCD display, the current input channel is indicated by the corresponding LED and on the LCD. If required, the input channel for adjustment can now be changed by depressing the required switch on the upper row. The level of that channel can be adjusted by depressing the nudge ∧∨ keys, the current level will be shown in dBs on the LCD display. A phase reversal can be applied to the input channel by depressing the INV switch. The phase reversal is indicated by a ↓ symbol on the LCD display positioned beside the corresponding input.

Note that the FAD, MAT and BYP buttons are inoperative in this mode.

© 2004 BEL Digital Audio Ltd.

Setup

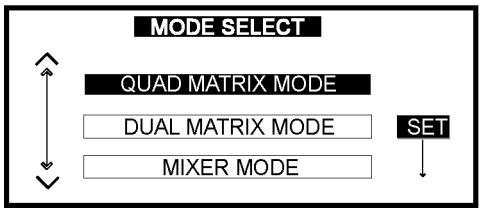
The setup function of the 2120 is accessed by depressing the SET key. Parameters adjustable under setup can be made to appear sequentially by repeatidly depressing the SET key. Each of the setup menus, with the exception of the memory recall, show values that can be adjusted by means of the nudge ∧∨ keys. The setup menu will time-out after 30 seconds if no adjustment is made. The functions available in setup are as follows:

Page 1. Memory functions

The first press of the SET key will enter the memory recall state. The word PROG on the lower portion of the LCD will flash. It is possible to browse the states of the 8 memories by pressing the input and output selection switches. Input switches 1 to 4 will display the memory settings 1 to 4, ***output*** switches 1 to 4 will display the memory settings 5 to 8. The memory setting are merely displayed up to this point, to activate a particular memory first select the required number as described above and then hit the same switch a second time.

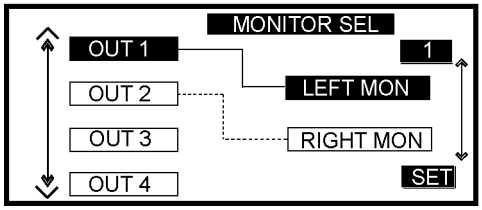
Page 2. Mode selection

The operational mode of the unit, Quad Matrix, Dual Matrix or Mixer may be selected here. The Nudge buttons makes the selection.



Page 3. Headphone monitor source selection

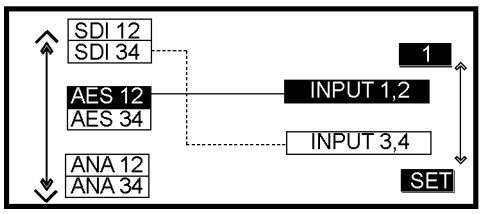
The output directed to the left or right headphone monitor channel can be selected here. To select a channel for the right monitor source press the SET key and then make a selection, to return to the left monitor source press the input 1 key.



© 2004 BEL Digital Audio Ltd.

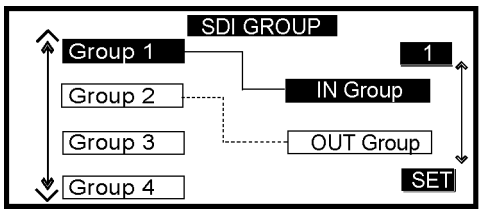
Page 4. Input source selection

The audio source selection is organized in pairs. The source channel for inputs 1/2 and then 3/4 can be selected here. The possible sources are SDI 1/2, SDI 3/4, AES 1/2, AES 3/4 Analog 1/2 or Analog 3/4. To select the input 3/4 source press the SET key and then select the required input source using the ∧ ∨ keys, to return to the input 1/2 source press the input 1 key.



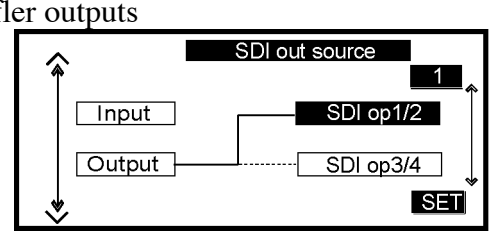
Page 5. SDI group selection

The input and output SDI group can be selected here. To select an output group press the SET key and then make a selection, to return to the input group selection press the input 1 key. The 2120 can accept SDI inputs on one group and embed outputs on another. The incoming embedded audio can be retained or deleted as described below.



SDI output select

The SDI outputs can be connected, in pairs, either to the SDI inputs (not shuffler inputs) or shuffler outputs



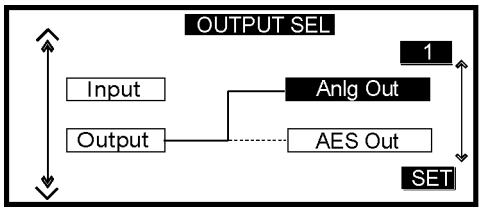
© 2004 BEL Digital Audio Ltd.

Analogue output select

The 4 analogue outputs can be connected to either the Shuffler inputs or outputs and this can be selected here. Depress set again to select AES outputs.

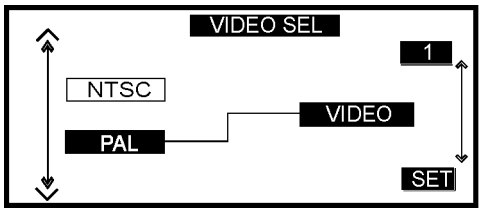
AES output select

The AES outputs can be connected to either the Shuffler inputs or outputs and this can be selected here. Depress the **1** input button to return to analog select.



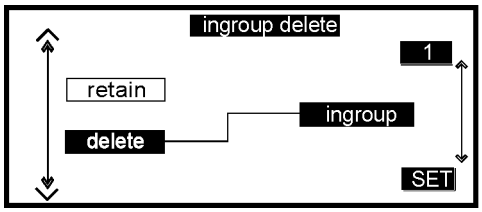
SDI video standard select

The SDI de-multiplexer can accept PAL or NTSC video standards. These can be selected here.



Ingroup deletion

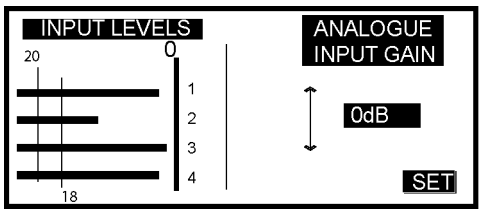
The incoming group selected by the shuffler can be deleted or retained. This facility can be selected here. If the incoming and outgoing groups are the same the shuffler will automatically delete the incoming group.



© 2004 BEL Digital Audio Ltd.

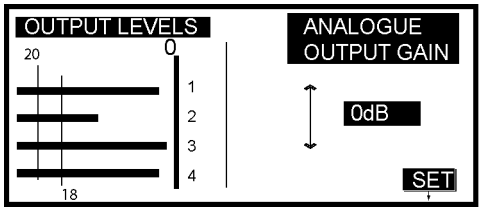
Input levels/ Analogue input gain adjustment

The left hand half of the LCD display carries an indication of the level of the inputs to the Shuffler. Note that these may come from SDI, AES or analogue sources. The right hand half of the screen allows the ANALOGUE INPUT GAIN to be adjusted. This setup menu item will not time out to give the opportunity for setting levels.



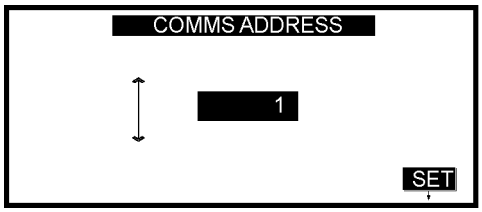
Output levels/ Analogue output gain adjustment

The left hand half of the LCD display carries an indication of the level of the outputs from the Shuffler. The right hand half of the screen allows the ANALOGUE OUTPUT GAIN to be adjusted. This setup menu item will not time out to give the opportunity for setting levels.



Communications address

This allows the address of the unit to be selected. The unit will only respond to serial commands that contain its address. The permitted range of addresses is 1 to 100.



© 2004 BEL Digital Audio Ltd.

RS422 Serial control

The BEL 2120 can be externally/ remotely controlled via the 9 pin RS422 socket on the rear panel. Units can be connected in cascade by linking the RS422 output connector of one unit to the RS422 input connector of the next. The RS422 signal is buffered by each unit and electro-mechanically bypassed during power down. When a recognized RS422 data word is received the BEL 2120B front panel will be locked out to avoid confusion.

Rear Panel Connectors

From the left these are:

Analogue inputs (upper)	15 way D female
Analogue outputs (lower)	15 way D female
SDI input	BNC 75ž
SDI output	BNC 75ž
AES I/O	15 way D female
RS422 in serial Port	9 Pin D female
RS422 out serial Port	9 Pin D female
Mains power	230/115VAC IEC 3 Pin A mains switch and fuseholder (230V - 250mA, 115V - 500mA)

Pin Connections

Audio inputs

Pin1	Ch1 +	Pin 9	GND
Pin 2	Ch1 -	Pin 10	GND
Pin 3	Ch2 +	Pin 11	GND
Pin 4	Ch2 -	Pin 12	GND
Pin 5	Ch3 +	Pin 13	GND
Pin 6	Ch3 -	Pin 14	GND
Pin 7	Ch4 +	Pin 15	GND
Pin 8	Ch4 -		

Audio outputs

Pin1	Ch1 +	Pin 9	GND
Pin 2	Ch1 -	Pin 10	GND
Pin 3	Ch2 +	Pin 11	GND
Pin 4	Ch2 -	Pin 12	GND
Pin 5	Ch3 +	Pin 13	GND
Pin 6	Ch3 -	Pin 14	GND
Pin 7	Ch4 +	Pin 15	GND
Pin 8	Ch4 -		

© 2004 BEL Digital Audio Ltd.

AES I/O

Pin 1	Ch1/2 + Out	Pin 9	GND
Pin 2	Ch1/2 -Out	Pin 10	GND
Pin 3	Ch3/4 +Out	Pin 11	GND
Pin 4	Ch3/4 - Out	Pin 12	GND
Pin 5	Ch1/2 + In	Pin 13	GND
Pin 6	Ch1/2 - In	Pin 14	GND
Pin 7	Ch3/4 + In	Pin 15	GND
Pin 8	Ch3/4 +-In		

RS422 IN

Pin 1	Chassis	Pin 6	GND
Pin 2	Tx -	Pin 7	Tx +
Pin 3	Rx +	Pin 8	Rx -
Pin 4	GND	Pin 9	Chassis
Pin 5	GND		

RS422 OUT

Pin 1	Chassis	Pin 6	GND
Pin 2	Rx -	Pin 7	Rx +
Pin 3	Tx +	Pin 8	Tx -
Pin 4	GND	Pin 9	Chassis
Pin 5	GND		

It is recommended that, where possible, all cables be good quality screened twisted pairs with the screening braid connected to pin 1 on the XLR connector. Optimum performance is obtained using double screened cable with separate ground returns. It is also recommended that 360 degree connection be made to the screening braid on the BNC connectors. Screened ‘D’ type connectors are also recommended.

EMC compliance

The BEL 2120 was designed and tested to comply with the EMC directive numbers EN55103, EN55022 and EN55082-1 when used as directed.

CE

© 2004 BEL Digital Audio Ltd.

Specification Bel Model 2120B

SDI I/O

InputsI/O	Serial component digital video signal 4:2:2, to SMPTE 259M 4 Channels from SDI(Groups 1 to 4). SMPTE 272M-A

Analogue Inputs

Inputs	4 channel differential
A/D	24 bit x 64 oversampled
Level	+6dB in for –9dB Digital. (max 15dB)
Noise	-105 dB wrt. Max input (Audio precision weighted 20Hz to 20kHz)
Bandwidth	20Hz to 20kHz ± 0.5dB
Input impedance	25kΩ differential

Analogue outputs

Outputs	4 Channels Differential
D/A	24 bit
Level	+6dB out for –9 dB digital in.(Max 15dB)
Output impedance	50Ω
Noise	-110dB wrt. Max output (Audio precision weighted 20Hz to 20kHz)
Bandwidth	20Hz to 20 kHz ± 0.5dB

Monitor output

2 channel analogue with source selector, min 8Ω

AES-EBU Digital I/O

Input	2 pairs AES-EBU 32 to 50 ks/sec
Output	2 pairs AES-EBU 48 ks/sec

General

Remote interface	RS422, 9.6kBaud
Power requirements	96/265 VAC 50/60 Hz
Power consumption	40W
Dimensions	428w x 44h x 20d (1U)
Net weight	7kg

© 2004 BEL Digital Audio Ltd.

The Bel2120B V2.0 Serial Protocols

Overview

Commands to be communicated to the remote unit (2120) are arranged in frames. These frames will then be sent to the remote unit which will always reply with either ACK for acceptance or NAK for rejection. Any requested reply then follows in the same frame format.

Frame format

Start Flag 0XAA
Destination Address
Source Address
Command
Data Count
Data
Checksum
End Flag 0XFE

The frame starts with a start character 0XAA which is alternating ones and zeros. This is followed by the destination address, the source address, the command code, the data count, the data, a checksum and an end flag 0XFE.

Start Flag

The start flag 0XAA may be sent at any time. If sent during a frame this will effectively cause the frame to restart.

Destination Address

This should be set to the same as the comms address for the target 2120. This will be returned by the remote unit as the source address.

Source Address

This should be set to 1 for 2120. This will be returned by the remote unit as the destination address.

Command

This character is the command for the remote unit and must fall in the range 0X80 to 0XEF. More details of the relevant codes are shown below.

Data count

This is the total number of data bytes following, up to a maximum of 127.

Data

The data required for the command is carried here. Each character can have a value of 0X00 to 0X7F i.e. 7 bits.

Checksum

This is the modulo 7 sum of characters in the frame between the destination address and the last data character inclusively. It is calculated thus:

```
DO
{
checksum = (character+checksum) AND 0X7F
}
```

© 2004 BEL Digital Audio Ltd.

FOR ALL CHARACTERS IN FRAME

End Flag

A character 0XFE ends the frame.

Commands

Commands to the 2120:

Code (hex)	Function	Reply
80	Prompt for reply	C0 – ACK (OK) C1 – NAK (send again)
81	Use first data char as a second command	ACK
82	Request unit identifier	ACK then C2
85	Send program number. Data count =1 then program number 0-7.	ACK
87	Request program number	ACK then C7
8C	Parameter reset	ACK
8D	Send 16 input gains. Data count=16 then 16 gain values as below	ACK
8E	Request 16 input gains	ACK then CE
8F	Send general data. Data count=6 then data as below	ACK
90	Request general data.	ACK then D0
91	Send output gains. Data count=4 then 4 gain values	ACK
92	Request output gains	ACK then D2
93	Send 1 input gain value. Data count=1 then input number and then gain value	ACK
94	Send mode. Data count =1 then mode value.	ACK

Replies

Replies, when requested (e.g. 82), will consist of frames that contain the original command value plus 0X40. So a request for an ident, 0X82, will elicit a reply of ACK then a frame containing 0XC2 and the ident string.

© 2004 BEL Digital Audio Ltd.

General data format

The send and request general data (8F, 90) commands communicate most switch settings to PC and 2120. The format for these is:

	Bit 7	Bit 6	Bit 5	Bit 4	Bit 3	Bit 2	Bit 1	Bit 0
Byte 0			Msb of bit 4	Input for out 3 Matrix mode	Msb of bit 2	Input for out 2 matrix mode	Msb of bit 0	Input for out 1 matrix mode
Byte 1		Msb of bit 5	Current output	Msb of bit 3	Current input		Msb of bit 0	Input for out 4 Matrix mode
Byte 2		Video mode	Msb of bit 4	Left monitor source	Remote Lock	Byp	Mat	Fad
Byte 3			Msb of bit 4	Output SDI group	Msb of bit 2	Input SDI group	Msb of bit 0	Right monitor source
Byte 4			Msb of bit 3		3,4 Input source	Msb of bit 0		1,2 Input source
Byte 5		Xfade	SDI 3,4output source	SDI 1,2 output source	Dual mode	Mat mix mode	Analogue output source	AES output source

Gain value format.

The data sent or received as gain values are formatted as follows: -
Channel one first.
Gain range +10dB to –30 dB value = 50 to 10 respectively
Value of 9 mutes that channel.

Where more than one bit is required such as Group number, the second bit is labeled Msb of bit n.
RS422 format: 8 data bits, no parity, two stop bits, 9600 Baud.

.

© 2004 BEL Digital Audio Ltd.

Appendix A

2120B operational description

The signal routing capabilities of the 2120B is shown in Fig 2.0

The LCD display in matrix mode was generated for ease of use but does not literally describe the operation of the 2120. Each output has 4 independent level adjustments associated with it. These adjustments are actually on the ***inputs*** not on the outputs as shown on the LCD. Inversion is also done on the inputs not outputs. As there is only one input routed to each output whether the level is set on input or output would seem to be academic. However, the effect of this can be seen by selecting one output and then setting different levels for each input. Changing the input select for this output then restores the set level value. Each output is independent so there are in effect 16 level settings in the 2120. Fig 2.1 Similarly the mixer mode has 16 level adjustments (independent from the matrix gains). Fig 2.2

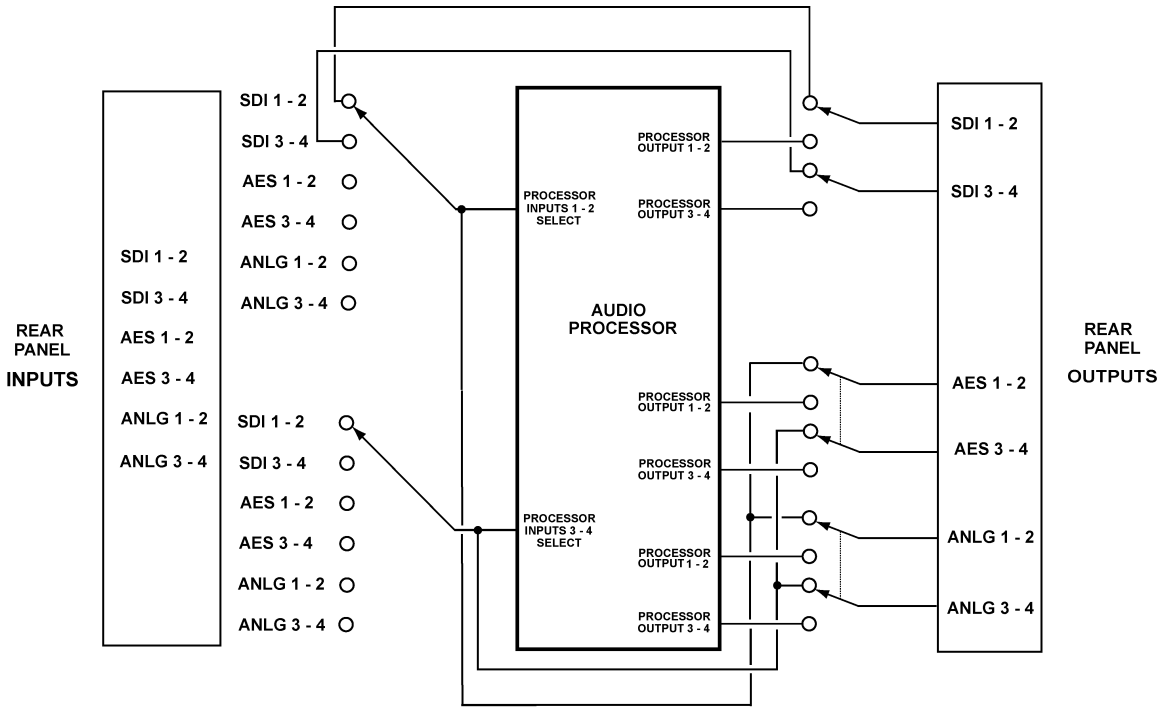

REAR PANEL INPUTS
SDI 1 - 2
SDI 3 - 4
AES 1 - 2
AES 3 - 4
ANLG 1 - 2
ANLG 3 - 4
SDI 1 - 2
SDI 3 - 4
AES 1 - 2
AES 3 - 4
ANLG 1 - 2
ANLG 3 - 4
SDI 1 - 2
SDI 3 - 4
AES 1 - 2
AES 3 - 4
ANLG 1 - 2
ANLG 3 - 4
PROCESSOR INPUTS 1 - 2 SELECT
PROCESSOR INPUTS 3 - 4 SELECT
AUDIO PROCESSOR
PROCESSOR OUTPUT 1 - 2
PROCESSOR OUTPUT 3 - 4
PROCESSOR OUTPUT 1 - 2
PROCESSOR OUTPUT 3 - 4
PROCESSOR OUTPUT 1 - 2
PROCESSOR OUTPUT 3 - 4
SDI 1 - 2
SDI 3 - 4
AES 1 - 2
AES 3 - 4
ANLG 1 - 2
ANLG 3 - 4
REAR PANEL OUTPUTS

Fig 2.0

© 2004 BEL Digital Audio Ltd.

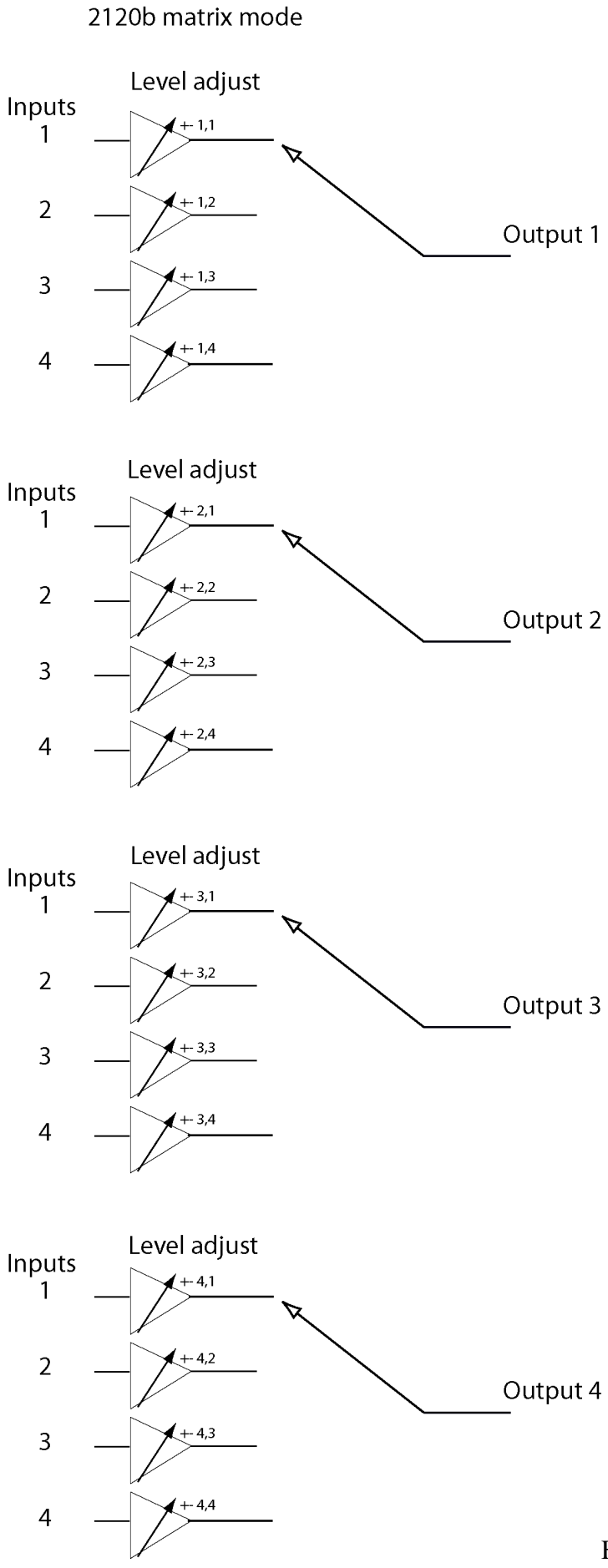


Fig 2.1

© 2004 BEL Digital Audio Ltd.

2120 Mixer mode

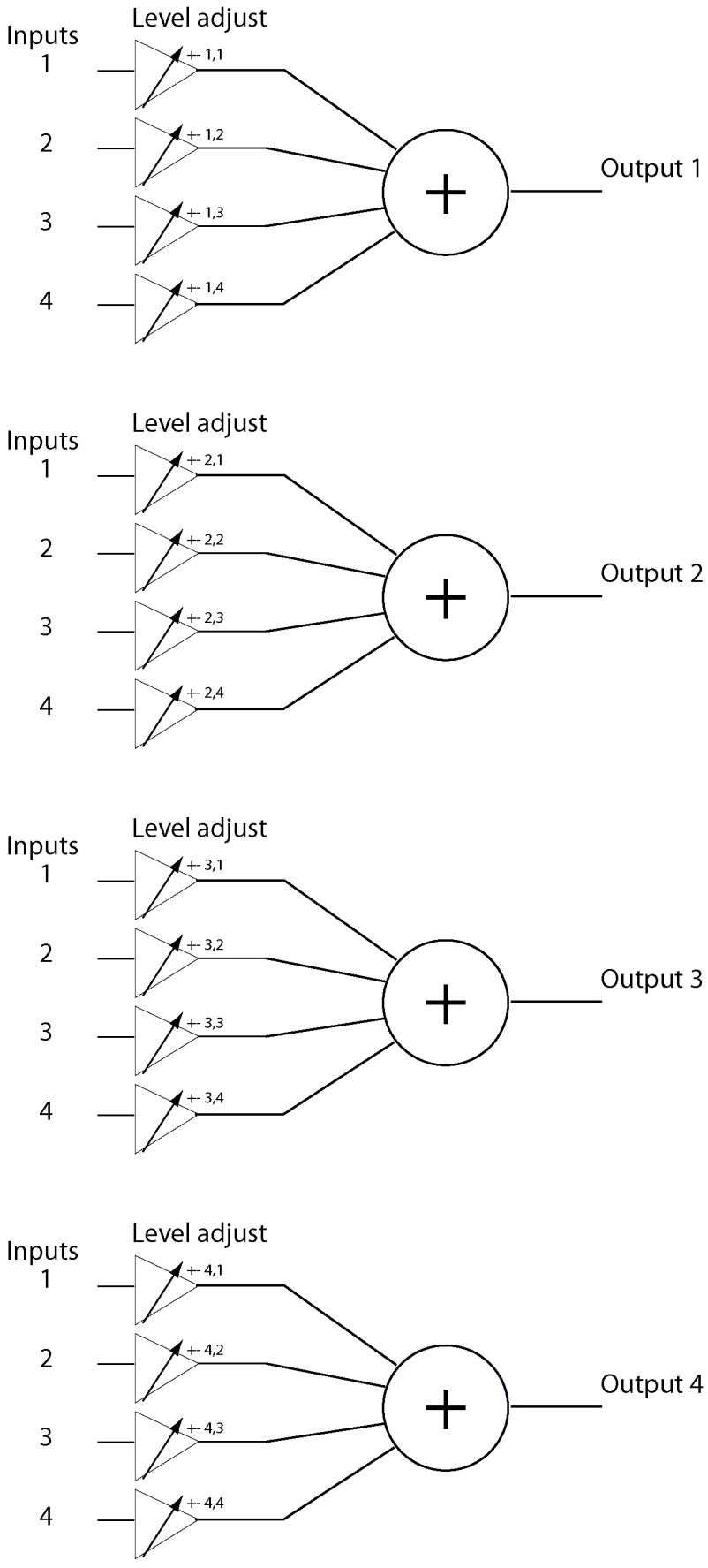


Fig 2.2

© 2004 BEL Digital Audio Ltd.